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(54) OPTICAL ANISOTROPIC FILM AND LIQUID CRYSTAL DISPLAY ELEMENT USING THAT

(57)Abstract:

PURPOSE: To enable a color display without being limited by the balance between the number of colors and transmissivity by forming a polymer by photopolymn. of a polymerizable liquid crystal compsn. in such a manner that the optical phase difference partly differs in the layer.

CONSTITUTION: This film has a polymer layer comprising a polymerizable liquid crystal compsn. in which the optical phase difference partly differs. As for the polymerizable liquid crystal compsn., a compsn. containing unifunctional acrylate or unifunctional methacrylate and showing a liquid crystal phase is preferably used. The unifunctional acrylate or unifunctional methacrylate is an acrylate or methacrylate of cyclic alcohol, phenol or aromatic hydroxy compd. having a liquid crystal structure having at least two six-member rings as a partial structure. Undesirable thermal polymn. is thereby prevented in the photopolmn. process in a liquid crystal state and a uniform orientation state can be fixed. The polymer layer is preferably formed to 0.1-100μm thick.

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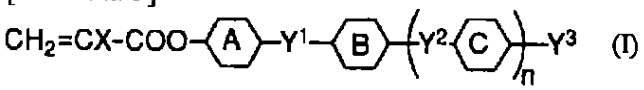
DETAILED DESCRIPTION

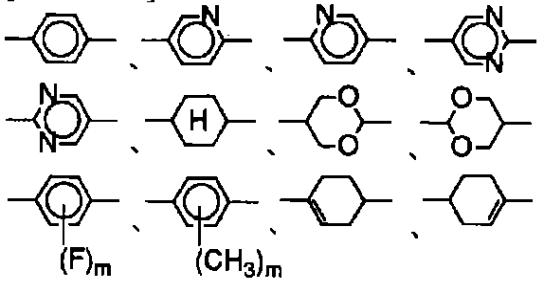
[Detailed Description of the Invention]
[0001]
[Industrial Application] this invention relates to the liquid crystal display element which has the optical different direction film which is the photopolymerization object of a polymerization nature liquid crystal constituent, and is characterized by optical phase contrast differing partially and its manufacture method, and this optical different direction film.
[0002]
[Description of the Prior Art] In order that the present electrochromatic display display device may obtain a bright display, power consumption builds in the large back light, and the size of the power consumption poses a problem which hits carrying an electrochromatic display display device in a portable device. As a means for solving this, Nishino etc. did not need a back light but the reflected type electrochromatic display display device which performs color display using the form birefringence of the both sides of liquid crystal and a phase contrast film is proposed (a Nikkei micro device, page 99 of the January, 1994 issue). However, by this method, since the laminating of two or more phase contrast films was needed when it is going to increase the number of color schemes from the principle, decline in a light transmittance was caused and there was a problem that a bright display was hard to be obtained.
[0003]
[Problem(s) to be Solved by the Invention] The technical problem which this invention tends to solve is to offer the liquid crystal display element using the optical different direction film which makes color display possible and its manufacture method, and this optical different direction film, without being restricted to the balance of the number of color schemes, and permeability.
[0004]
[Means for Solving the Problem] This technical problem finds out that it is solvable by using the optical different direction film with which optical phase contrast differs for every portion corresponding to the pixel of a liquid crystal display element and whose number is one as a phase contrast film, and this invention person etc. came to offer this invention, as a result of examining wholeheartedly the above-mentioned The means for solving a technical problem.
[0005] That is, the liquid crystal display element which has the manufacture method of this optical different direction film as the optical different direction film which this invention is the photopolymerization object of a polymerization liquid crystal constituent as the first invention, and is characterized by optical phase contrast differing partially, and the 2nd invention, and has this optical different direction film as the 3rd invention is offered.
[0006] The optical different direction film of the first invention is explained in detail first. The optical different direction film of this invention is characterized by having the polymerization layer from which it is the photopolymerization object of a polymerization liquid crystal constituent, and optical phase contrast differs partially.
[0007] As a polymerization nature liquid crystal constituent used by this invention Since the induction of the thermal polymerization which is not meant in the case of photopolymerization in a liquid crystal

state is avoided and a uniform orientation state is fixed The 1st single organic-functions acrylate or the 1st single organic-functions methacrylate which is the acrylic acid or methacrylic ester of the cyclic alcohol which has as a substructure the mesomorphism skeleton which has at least two 6 member rings, a phenol, or an aromatic hydroxy compound is contained. It is desirable to use the polymerization nature liquid crystal constituent characterized by showing a liquid crystal phase. As the single organic-functions acrylate which has a mesomorphism skeleton as a substructure, or single organic-functions methacrylate, such single organic-functions acrylate or single organic-functions methacrylate is a general formula (I), for example.
[0008]
[Formula 5]

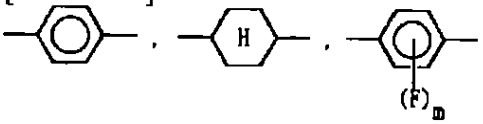


(I)

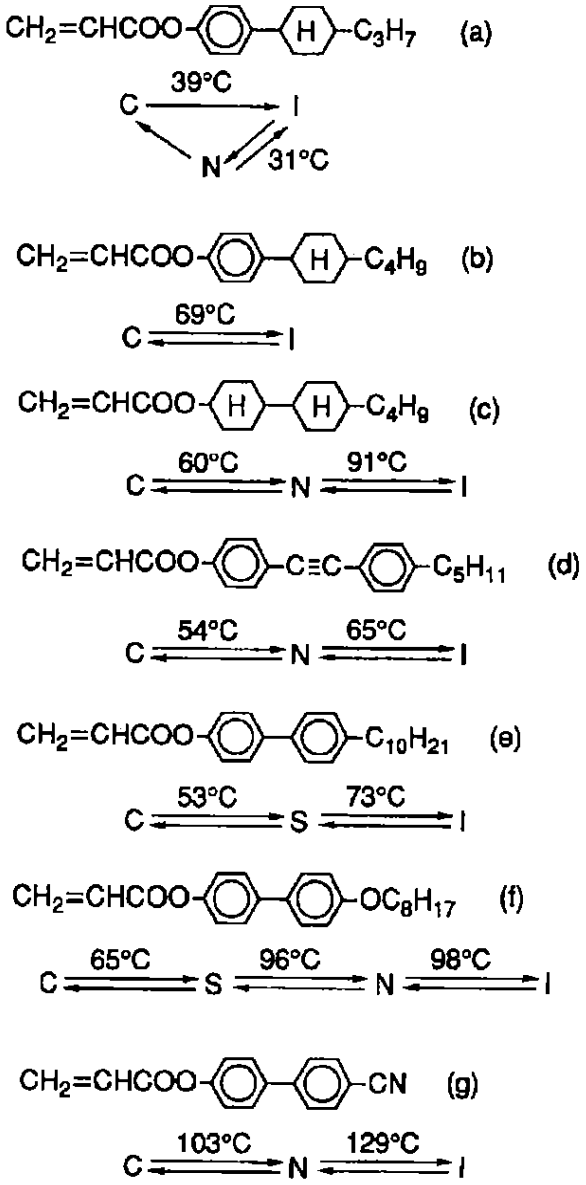
[0009] (Independent-like [6 member rings / X expressing a hydrogen atom or a methyl group among a formula. / A, B, and C] respectively) [0010]
[Formula 6]



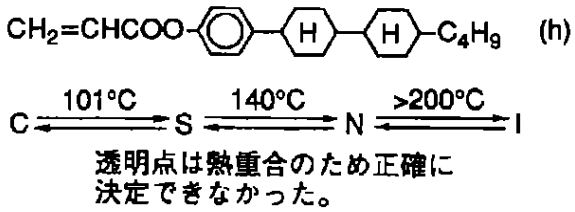
[0011] ******, n expresses the integer of 0 or 1, and m expresses the integer of 1 to 4. In independent Y1 and Y2, respectively Single bond, -CH2CH2-, -CH2O-, - OCH2-, -COO-, -OCO-, -C**C-, - CH=CH-, - CF=CF-, -(CH2)4-, -CH2CH2CH2O-, -OCH2CH2CH2-, - expressing CH2=CHCH2CH2- or -CH2CH2 CH=CH-, Y3 expresses a hydrogen atom, a halogen atom, a cyano group, the alkyl group of the carbon atomic numbers 1-20, an alkoxy group, an alkenyl machine, or an alkenyloxy machine The compound expressed can be mentioned. Setting to the above-mentioned general formula (I) also especially in it, 6 member rings A, B, and C are on an independent target, respectively. [0012]
[Formula 7]



[0013] Y1 and Y2 express single bond or -C**C- in independent by ******(ing) and m expressing the integer of 1 or 2, respectively, and Y3 has a desirable compound showing a halogen atom, a cyano group, the alkyl group of the carbon atomic numbers 1-20, or an alkoxy group.
[0014] Although the phase transition temperature is indicated to be the example of the typical thing of such a compound, the single organic-functions acrylate or the single organic-functions methacrylate compound which can be used by this invention is not limited to these compounds.
[0015]
[Formula 8]



[0016]
[Formula 9]



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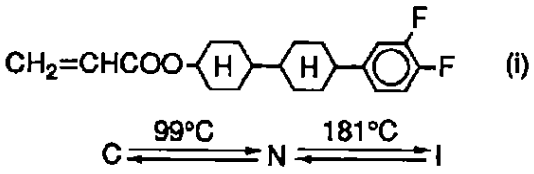
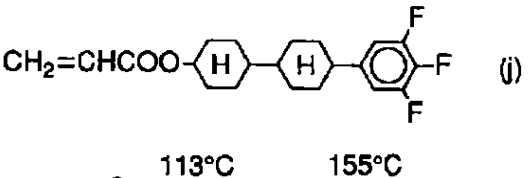
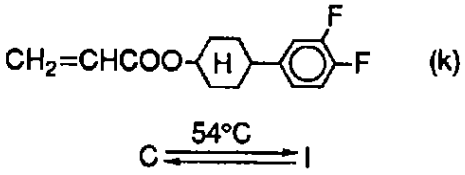
決定できなかった。



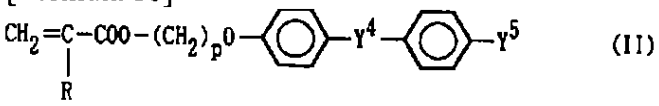




[0017] (A cyclohexane ring expresses a transformer cyclohexane ring during the above, and in a crystal phase and N, a nematic phase and S express a smectic phase, I expresses [C of a phase-transition-temperature scheme] an isotropic liquid phase, and a number expresses a phase transition temperature.) Moreover, to the polymerization nature liquid crystal constituent used by this invention, you may add the 2nd single organic-functions acrylate which has as a substructure the mesomorphism frame known until now, or the 2nd single organic-functions methacrylate compound. the polymerization nature liquid crystal constituent obtained at this time -- a room temperature -- setting -- enantio -- fatty tuna -- it is desirable to show a pick nematic-liquid-crystal phase As the single organic-functions acrylate which can be used here, or single organic-functions methacrylate, it is a general formula (II), for example.

[0018]

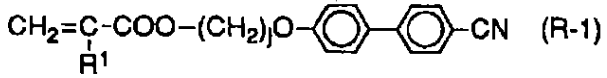
[Formula 10]



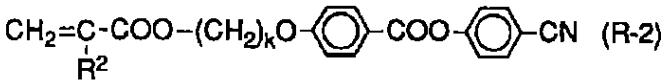
[0019] (-- R expresses a hydrogen atom or a methyl group among a formula, p expresses the integer of 2-12, Y4 expresses single bond or -COO-, and Y5 expresses a cyano group, the alkyl group of the carbon atomic numbers 1-6, an alkoxy group, or a phenyl group The compound expressed with) can be mentioned and the following compounds can specifically be mentioned.

[0020]

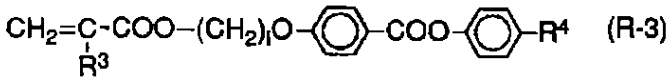
[Formula 11]



(R-1)



(R-2)



(R-3)

[0021] (R1, R2, and R3 express a hydrogen atom or a methyl group in independent among a formula, respectively, j, k, and l express the integer of 2-12 in independent, respectively, and R4 expresses the alkyl group or phenyl group of the carbon atomic numbers 1-6.)
Thus, the polymerization nature liquid crystal constituent used by this invention may contain only the 1st single organic-functions (meta) acrylate, or may contain only the 2nd single organic-functions (meta) acrylate, and may use together the 1st and 2nd single organic-functions (meta) acrylate.
[0022] as a polymerization nature constituent -- the [the 1st and] -- when using together 2 **** organic-functions (meta) acrylate, as for the content of the 2nd single organic-functions (meta) acrylate, it is desirable that it is 50 or less % of the weight to the 1st single organic-functions (meta) acrylate This is because there is an inclination for the mechanical strength of an optical different direction film and thermal resistance which are obtained to be inferior as the content of the 2nd single organic-functions (meta) acrylate increases.
[0023] Moreover, when controlling partially the orientation state of a polymerization nature liquid crystal constituent by electric field in the case of optical different direction film manufacture, it is desirable that the dielectric constant anisotropy of a polymerization nature liquid crystal constituent is positive, and it is desirable that anisotropy deltaepsilon of a dielectric constant is especially 0.5 or more. In order to obtain such a polymerization nature liquid crystal constituent, it is desirable to contain the 1st and 2nd single organic-functions (meta) acrylate which has a cyano group.
[0024] Moreover, to the polymerization nature liquid crystal constituent used by this invention, the total amount in a polymerization nature liquid crystal constituent may add the liquid crystal compound which does not have the polymerization nature functional group in the range which does not exceed 10 % of the weight. As a liquid crystal compound which does not have the polymerization nature functional group, if [, such as a nematic-liquid-crystal compound, a smectic-liquid-crystal compound, and a cholesteric-liquid-crystal compound,] it is usually recognized as liquid crystal by this technical field, it can use without a limit especially. However, since it is in the inclination for the mechanical strength of the optical different direction film obtained to fall as the addition increases, it is necessary to adjust an addition suitably.
[0025] Moreover, although it has the polymerization nature functional group, the compound in which mesomorphism is not shown can also be added. As such a compound, be [what is necessary / just although it is usually recognized as a macromolecule formation nature monomer or macromolecule formation nature oligomer by this technical field], especially an acrylate compound is desirable.
[0026] Although these liquid crystal compounds or a polymerization nature compound may be chosen suitably, it may combine and you may add, it is required to adjust the addition of each component so that the mesomorphism of the polymerization nature liquid crystal constituent obtained at least may not be lost.
[0027] Moreover, to the polymerization nature liquid crystal constituent used by this invention, you may add a photopolymerization initiator and a sensitizer for the purpose of raising the polymerization reactivity. Here, as a photopolymerization initiator which can be used, well-known benzoin ether, benzophenones, acetophenones, and benzyl ketals can be mentioned, for example. The addition has 10 or less desirable % of the weight to a polymerization nature liquid crystal constituent, and especially its

5 or less % of the weight is desirable.
[0028] Moreover, to the polymerization nature liquid crystal constituent used by this invention, in order to raise the preservation stability, you may add a stabilizer. A hydroquinone well-known as a stabilizer which can be used here, hydroquinone monoalkyl ether, a tertiary butyl catechol, etc. can be mentioned. To the polymerization nature liquid crystal constituent with 0.05 or less desirable % of the weight further used by this invention, the addition of the stabilizer is the purpose which is twisted and introduces spiral structures, such as nematic orientation or cholesteric orientation, and may add an optical-activity compound. Even if itself does not need to show mesomorphism and has the polymerization nature functional group, it is not necessary to have the optical-activity compound which can be used here. Moreover, the sense of the torsion can be suitably chosen for the purpose to be used. The pelargonic-acid cholesterol which has a cholesteryl machine as an optical-activity machine as such an optical-activity compound, for example, "CB-15" which has 2-methyl butyl as stearin acid cholesterol and an optical-activity machine, "C-15" (above product made from BDH), "S-1082" (Merck Co. make), "S-811" (Merck Co. make) which has 1-methyl heptyl machine as "CM-19", "CM-20", "CM" (above Chisso Corp. make), and an optical-activity machine, "CM-21", and "CM-22" (above Chisso Corp. make) can be mentioned.
[0029] Moreover, although the optical phase contrast (retardation) of the optical different direction film of this invention takes the value which changes respectively with portions corresponding to a pixel, the range of the value being in the range of 0-1.8 microns is 0-1.2 microns desirable still more preferably. As for the form and size of a portion corresponding to the pixel which takes a uniform retardation, it is desirable that can completely set up freely and even patterns, such as a circle whose size is about dozens of cm, a triangle, and a pattern, choose suitably according to the use from a pixel with the minute quadrilateral whose one side is about 60 microns.
[0030] The polymerization layer thickness in the optical different direction film of this invention has the desirable range of 0.1-100 microns, and its range which is 0.5-50 microns is especially desirable. moreover, the polymerization layers with the above optical different direction film of this invention -- it may be independent and may be pinched between the thing with which this polymerization layer was supported on the transparency substrate, or two transparency substrates Moreover, what imprinted the polymerization layer to the 3rd transparency substrate can be used similarly.
[0031] Moreover, you may form a protective layer in the front face of an optical different direction film using the resin of thermosetting or a photoresist in order to protect the front face of the optical different direction film of this invention. Furthermore, a this optical different direction film can be used as a component part of a liquid crystal cell by forming transparent electrodes, such as ITO, in the optical different direction film front face of this invention. In this case, in order to avoid damage on the optical different direction film by the heat at the time of ITO electrode formation etc., it is desirable to form in an optical different direction film front face the protective layer of the resin of the thermosetting or photoresist which has thermal resistance.
[0032] Next, the manufacture method of this optical different direction film that is the 2nd invention is explained in detail. The optical different direction film of this invention can be manufactured by fixing an orientation state by [corresponding to the pixel of a liquid crystal display element] controlling applied voltage for every portion, changing the orientation state of a polymerization nature liquid crystal constituent, and irradiating energy lines, such as ultraviolet rays and an electron ray, in this state at a polymerization nature liquid crystal constituent. As such a manufacture method, especially this invention offers the following three manufacture methods.
(The manufacture method 1)
(1) an electrode -- a layer -- having -- orientation -- processing -- carrying out -- having had -- the -- one -- transparency -- a substrate -- an electrode -- a layer -- having -- orientation -- processing -- carrying out -- having had -- the -- two -- a substrate -- between -- a polymerization -- a sex -- liquid crystal -- a constituent -- intervening -- making -- the -- one -- a process -- (-- two --) -- the above -- two -- a sheet -- a substrate -- between -- every pixel -- applied voltage -- the 2nd process which irradiates light from a 1st transparency substrate side, and (3) -- the 3rd process (the manufacture method 2) which exfoliates

the 1st transparency substrate and the 2nd substrate
(1), controlling applied voltage for every pixel between the 1st [which has an electrode layer] transparency substrate by which orientation processing was carried out, and the 1st process (2) aforementioned two substrates which make a polymerization nature liquid crystal constituent intervene between the 2nd substrate which has an electrode layer, and by which orientation processing was carried out The 2nd process which irradiates light from a 1st transparency substrate side, and the 3rd process which exfoliates the (3) 2nd substrate (the manufacture method 3)
(1) Offer the manufacture method of an optical different direction film of having the 2nd process which irradiates light, controlling applied voltage for every pixel between the 1st process (2) aforementioned two substrates which make a polymerization nature liquid crystal constituent intervene between two transparency substrates which have an electrode layer, and by which orientation processing was carried out.
[0033] moreover, as a method of acquiring the orientation state which changes with voltage impression other than the above-mentioned this invention manufacture method After making a polymerization nature liquid crystal constituent pinch between two substrates which have an electrode layer and by which orientation processing was carried out, After irradiating an energy line and making the orientation state by predetermined voltage fix, putting the mask which an energy line penetrates only into the portion corresponding to a desired pixel on this substrate upper surface, and impressing predetermined voltage, a mask is removed further. There is also a method of manufacturing the optical different direction film with which the orientation state which changes with predetermined voltage was fixed by irradiating an energy line, impressing the voltage similarly changed by the portion corresponding to a pixel also about the portion for which an energy line is not irradiated.
[0034] The manufacture method of the optical different direction film of this invention is explained still in detail. this invention is set to reach (the manufacture method 1) (the manufacture method 2). The 1st [which has an electrode layer] transparency substrate by which orientation processing was carried out, and the 2nd substrate which has an electrode layer and by which orientation processing was carried out It arranges so that voltage impression of two transparency substrates which have an electrode layer in (the manufacture method 3) and by which orientation processing was carried out may be possible, and the above-mentioned polymerization nature liquid crystal constituent is made to intervene between these two substrates.
[0035] As a transparency substrate used at this time, the substrate which has an electrode layer is required. If a concrete example is given, a glass substrate with ITO, a plastic plate with ITO, etc. can be mentioned. Moreover, it is desirable to carry out orientation processing to these substrates. As orientation processing, the rubbing processing which rubs a substrate front face with cloth etc., or the method vacuum deposition of slanting of SiO2 can be mentioned, for example. Especially a rubbing approach is desirable from the simple nature. When a suitable stacking tendency cannot be obtained by carrying out rubbing of the substrate front face with cloth etc., according to a well-known method, organic thin films, such as a polyimide thin film or a polyvinyl alcohol thin film, may be formed in a substrate front face, and rubbing of this may be carried out with cloth etc.
[0036] Subsequently, light is irradiated from a transparency substrate side, controlling applied voltage for every pixel of two substrates. As a means to impress voltage between electrode layers, although the static drive or the time-sharing driving method used for the usual liquid crystal display element can be used and desirable applied voltage is suitably adjusted by the distance between the dielectric constant anisotropy of a polymerization nature liquid crystal constituent, or a substrate, the alternating voltage beyond 0.5V is desirable.
[0037] Otherwise as a method of changing the orientation state of a polymerization nature liquid crystal constituent for every portion corresponding to the pixel of a liquid crystal display element After making a polymerization nature liquid crystal constituent pinch between two substrates, the mask which penetrates an energy line is put only on the portion corresponding to the pixel of a request on this substrate upper surface. Irradiate an energy line, carrying out orientation of the polymerization nature liquid crystal constituent in a magnetic field with arbitrary directions and strength, make the orientation

state by the magnetic field fix, and a non-irradiated portion also makes an energy line the same further. By making an energy line irradiate, the optical different direction film with which the orientation state which changes with portions corresponding to a pixel was fixed can be manufactured, changing magnetic field strength and a direction.

[0038] Moreover, when it fixes the orientation of a polymerization nature liquid crystal constituent by impression of a magnetic field, it is not necessary to prepare an electrode layer in a substrate, and can use, without asking an organic material and inorganic material as a substrate. If a concrete example is given, as an organic material, silicon, glass, etc. can be mentioned, for example as a polyethylene terephthalate, a polycarbonate, a polyimide, a polymethyl methacrylate, polystyrene, polyethylene, a polyvinyl chloride, a polytetrafluoroethylene, a polychlorotrifluoroethylene resin, a polyarylate, a polysulfone, a cellulose, a polyether ether ketone, and inorganic material.

[0039] Furthermore, although the oriented structure of the polymerization nature liquid crystal constituent in the portion which is not impressing the place outside electric field, a magnetic field, etc. is dependent on orientation processing of a substrate, and the concentration of the optical-activity compound in a polymerization nature liquid crystal constituent, the oriented structure can preferably [choosing a suitable orientation state by the use of an optical different direction film], and specifically mention the following oriented structures.

[0040] Angle of torsion can make the torsion nematic orientation of 90 or less degrees able to counter with a fixed interval, can arrange it so that angle of torsion of a request of two substrates which carried out rubbing, for example of each direction of rubbing may be made, and it can acquire it by making a polymerization nature liquid crystal constituent pinch in the meantime.

[0041] Chiral nematic orientation or cholesteric orientation can make two substrates from which level orientation is acquired able to counter with a fixed interval, and can be acquired by making the polymerization nature liquid crystal constituent which adjusted the spiral pitch (P) in the meantime pinch. Moreover, it can obtain also by making the polymerization nature liquid crystal constituent which adjusted the spiral pitch (P) on one substrate from which level orientation is acquired support with fixed thickness.

[0042] Moreover, although it depends for the orientation state of an optical different direction film on orientation processing of a substrate as mentioned above when it does not contain an optical-activity compound in a polymerization nature liquid crystal constituent, the oriented structure can preferably [choosing a suitable orientation state by the use of an optical different direction film], and specifically mention the following oriented structures.

[0043] A homeotropic orientation can make two substrates from which perpendicular orientation is acquired able to counter with a fixed interval, and can be obtained by making a polymerization nature liquid crystal constituent pinch in the meantime.

[0044] Homogeneous orientation can be made to be able to counter with a fixed interval, can be arranged so that the angle each direction of rubbing of whose is 0 or 180 degrees about two substrates which carried out rubbing, for example may be made, and it can be obtained by making a polymerization nature liquid crystal constituent pinch in the meantime.

[0045] The hybrid orientation which changes continuously from perpendicular orientation to level orientation in the direction of polymerization nature liquid crystal constituent layer thickness can make the substrate which carried out rubbing, for example, and the substrate from which perpendicular orientation is acquired able to counter with a fixed interval, and can be acquired by making a polymerization nature liquid crystal constituent pinch in the meantime.

[0046] With the combination of the orientation and the orientation processing of a substrate by the place, the orientation state of a polymerization nature liquid crystal constituent can be partially changed outside electric field, a magnetic field, etc. as mentioned above. As for photopolymerization, it is desirable to perform energy lines, such as ultraviolet rays or an electron ray, by irradiating the polymerization nature liquid crystal constituent supported between two above-mentioned substrates, therefore temperature with the suitable substrate by the side of an irradiation side must be given at least. Although the temperature in the case of a polymerization must be the temperature at which the liquid crystal state of a

polymerization nature liquid crystal constituent is held, it is desirable to carry out a polymerization at the temperature near a room temperature from the meaning which avoids the induction of the thermal polymerization which is not meant.

[0047] Suitable transparency must be given to the substrate by the side of an irradiation side at least, when making a polymerization nature liquid crystal constituent pinch and performing photopolymerization between two substrates, since it is above.

[0048] Subsequently, according to the purpose of use, one sheet or both of the substrates which were used as mentioned above on the occasion of manufacture are exfoliated. In order to give detachability good to a substrate in order to exfoliate a substrate easily at this time, it is desirable to form the thin film of an organic material etc. in a substrate front face beforehand. As such an organic material, the mixture of fluorine-ized polymer and polyvinyl alcohol, such as a polytetrafluoroethylene, and diol compounds, such as 1 and 8-octanediol, lecithin, etc. can be mentioned.

[0049] The optical different direction film of this invention which has the polymerization layer to which a partially different oriented structure was fixed by the above manufacture methods can be obtained. Next, the liquid crystal display element which is the 3rd invention is explained in detail. The liquid crystal display element of this invention is characterized by having the optical different direction film which is the first invention. After exfoliating the state where the polymerization layer was pinched between two transparency substrates used on the occasion of manufacture as an optical different direction film which can be used for the liquid crystal display element of this invention, the state of only a polymerization layer where the polymer was supported on [of one sheet] the transparency machine, or at least one substrate, the thing in the state where the polymerization layer was imprinted can be raised to the 3rd transparency substrate. Moreover, as a liquid crystal display element of this invention, the Twisted Nematic type, a super twisted nematic type, a phase transition type, a guest host type, and a strong dielectric liquid crystal display element can be used, and the liquid crystal display element which has the modulated light layer of macromolecule distributed type, for example, NCAP, and PDLC can also be used. Moreover, driver voltage can also use low suitably the polymer network type liquid crystal display element (PN-LCD) characterized by having the three-dimensions network structure of a transparency solid matter as a modulated light layer. Although it is desirable to choose suitably according to the kind of liquid crystal display element as for the drive method of these liquid crystal display elements, as for the Twisted Nematic type or macromolecule distributed type, it is desirable from the point of display capacity to drive using an active element like a TFT (TFT) method.

[0050] The structure of the liquid crystal display element of this invention is described below. Although the liquid crystal display element of this invention has the above optical different direction films and a this optical different direction film is usually arranged between a polarizing plate and a liquid crystal cell, the optical different direction film which has the above electrode layers can be arranged and used into a liquid crystal cell.

[0051] In the liquid crystal display element of this invention, in also being able to transpose one of two polarizing plates to a reflecting plate and using a reflecting plate, when it serves also as the function as a reflecting plate to one electrode side of a liquid crystal display element, since the parallax of a liquid crystal display element is improved, it is desirable.

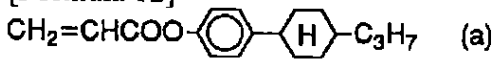
[0052] Moreover, although the angle which the polarization shaft of a polarizing plate and the optical axis of the optical different direction film of this invention make is suitably adjusted by the liquid crystal display element to constitute, it is desirable to arrange so that the angle of 45 degrees may generally be made. Moreover, when using two polarizing plates, as for the polarization shaft of the two polarizing plates, it is mutually desirable from the point of contrast parallel or to arrange so that it may intersect perpendicularly.

[0053] Moreover, in order to raise the color purity of coloring based on optical phase contrast, you may add and use the micro light filter usually used for the liquid crystal display element of this invention.

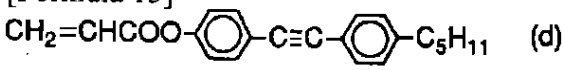
[0054]

[Example] Hereafter, the example of this invention is shown and this invention is explained still more concretely. However, this invention is not limited to these examples.

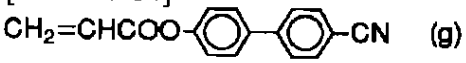
(Example 1)
Formula (a)
[0055]
[Formula 12]



[0056] The ******** 47.5 weight section and a formula (d)
[0057]
[Formula 13]



[0058] The ******** 47.5 weight section and a formula (g)
[0059]
[Formula 14]



[0060] The polymerization nature liquid crystal constituent (A) which consists of the ******** 5 weight section was adjusted. the obtained constituent -- a room temperature (25 degrees C) -- enantio -- fatty tuna -- the pick nematic phase was shown and the transition temperature from a nematic phase to an isotropic liquid phase was 52 degrees C Moreover, ne (extraordinary index) in 25 degrees C was [the anisotropy of 1.51 and a dielectric constant of 1.67 and no (Tsunemitsu refractive index)] +0.7. The polymerization nature liquid crystal constituent (B) which becomes the polymerization nature liquid crystal (constituent A) 99 weight section from the photopolymerization initiator "inter-record-gap-651" (product made from Ciba-Geigy) 1 weight section was obtained. Next, 3.0g polyvinyl alcohol (polymerization degree 500 [about]) and 3.0g 1 and 8-octanediol were dissolved in the mixed solvent which consists of 100g of water, and ethanol 100g, and the solution of the constituent for liquid crystal orientation processing agents was produced. The spin coat was carried out to size 25mmx30mm as shows this solution in a view 1, and the glass substrate (i) which has an electrode layer (A), (B), and (C) as an ITO transparent-electrode layer. Most solvents were dried on this spin coat. The deposit of 1 and 8-octanediol was found on the glass substrate at this time, and the uniform film was not obtained. Next, after heating this glass substrate for 5 minutes at 110 degrees C, it cooled to the room temperature, and the uniform film without the deposit of 1 and 8-octanediol was obtained. In the direction which has shown this in the view 1, rubbing processing was carried out and the glass substrate (i-R) by which orientation processing was carried out was produced.
[0061] next, it is shown in the 2nd view -- as -- the same size as a glass substrate (i) -- and the spin coat of the polyimide orientation processing agent "AL-1254" (Japan Synthetic Rubber Co., Ltd. make) was carried out on the glass substrate (ii) which has an ITO transparent-electrode layer all over a substrate This substrate was maintained for 80 minutes at 180 degrees C, and the polyimide film was formed on the substrate. In the direction which has shown this polyimide film in the view 2, rubbing processing was carried out and the glass substrate (ii-R) by which orientation processing was carried out was produced. The field which carried out rubbing processing of a glass substrate (i-R) and the glass substrate (ii-R) was made to counter, and the polymerization nature liquid crystal constituent (B) was made to pinch in the meantime. The angle at which the direction of rubbing mutual to 9 microns makes the interval between the glass substrates at this time was set up so that it might become 180 degrees. When the polymerization nature liquid crystal constituent pinched between two glass substrates was observed between two polarizing plates which intersect perpendicularly, it was confirmed that uniform 1 shaft orientation (homogeneous orientation) is acquired. Next, the sine wave with a frequency [of 3.3Vrms(es)] of 1kHz was impressed between 2.9Vrms(es), the electrode layer (C), and the counterelectrode between 4.1Vrms(es), the electrode layer (B), and the counterelectrode between the

electrode layer (A) of a glass substrate (i), and the counterelectrode. The optical different direction film which irradiated the ultraviolet rays of the quantity of light of 160 mJ/cm2 using the ultraviolet ray lamp (the product made from UVP, UVGL-25) in the room temperature, was made to photopolymerize a polymerization nature liquid crystal constituent, and was pinched by two glass substrates where voltage is impressed to this polymerization nature liquid crystal constituent was obtained. After keeping this at 150 degrees C for 5 minutes, it cooled in the room temperature. The glass substrate (i-R) was exfoliated from the optical different direction film after cooling to the room temperature, and the optical different direction film supported by the glass substrate (ii-R) was obtained. When the interference color was observed between two polarizing plates which intersect perpendicularly so that the angle of the optical axis (the direction of rubbing) of an optical different direction film and the polarization shaft of a polarizing plate to make might turn into 45 degrees in a this optical different direction film, the result as shown in a view 3 was obtained. In the interference color of the portion to which the interference color of the portion to which the interference color of the portion which was in contact with the electrode layer (A) was in contact with red and the electrode layer (B) was in contact with green and the electrode layer (C), the portions of blue and others presented yellowish green and the interference color uniform in an electrode layer different partially [the optical different direction film of one sheet]. Therefore, it is in Ming that the optical different direction film with which optical phase contrast differs partially corresponding to each pixel was obtained. Moreover, even if it maintained the this optical different direction film at the temperature of 150 degrees C, the uniform interference color did not change but its thermal resistance was also satisfactory at all.

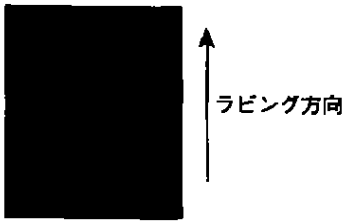
(Example 2) The spin coat of the polyimide orientation processing agent "AL-1254" was carried out to size 25mmx30mm as shown in a view 4, and the glass substrate (iii) which has an electrode layer (A'), (B'), and (C') as an ITO transparent-electrode layer. This substrate was maintained for 80 minutes at 180 degrees C, and the polyimide film was formed on the glass substrate. In the direction which has shown this polyimide film in the view 4, rubbing processing was carried out and the glass substrate (iii-R) by which orientation processing was carried out was produced. next, it is shown in a view 5 -- as -- the same size as a glass substrate (iii) -- and the spin coat of the polyimide orientation processing agent "AL-1254" was carried out on the glass substrate (iv) which has an ITO transparent-electrode layer all over a substrate This substrate was maintained for 80 minutes at 180 degrees C, and the polyimide film was formed on the glass substrate. In the direction which has shown this polyimide film in the view 5, rubbing processing was carried out and the glass substrate (iv-R) by which orientation processing was carried out was produced. The field which carried out rubbing processing of a glass substrate (iii-R) and the glass substrate (iv-R) was made to counter, and the anisotropy of 0.189 and a dielectric constant made the nematic-liquid-crystal constituent "PN-019" (made in Roddick) of 7.2 pinch [anisotropy / of a refractive index] in the meantime. The angle at which the direction of rubbing mutual to 5.3 microns makes the interval between the glass substrates at this time was set up so that it might become 90 degrees, and it produced the Twisted Nematic liquid crystal cell. The optical different direction film produced in the example 1 was put on this Twisted Nematic liquid crystal cell, and the polarization shaft has arranged this between the parallel polarization films of two sheets mutually. At this time, the polarization shaft of the polarization film of two sheets made the angle of 45 degrees to the optical axis (the direction of rubbing) of an optical different direction film. Moreover, each direction of rubbing of two substrates which constitute the Twisted Nematic liquid crystal cell should become in parallel or right-angled to the polarization shaft of a polarization film. The liquid crystal cell and the optical different ****** film were piled up so that might carry out, the portion whose interference color of an optical different direction film is red might lap with the portion of the electrode layer (A') of a liquid crystal cell, a portion with the green interference color of an optical different direction film might lap with the portion of the electrode layer (B') of a liquid crystal cell and the portion whose interference color of an optical different direction film is blue might lap with the portion of the electrode layer (C') of a Thus, at the time of no impressing, as for the produced liquid crystal display element, skillful coloring with the blue portions [of red and an electrode layer (B')] portions of green and an electrode layer (C') was obtained [voltage] for the portion of an electrode layer (A'). Moreover, as for the portion of an

electrode layer (A'), coloring with vivid yellow of the portions of red and an electrode layer (C') was obtained by impression of voltage, as for the portions of green and an electrode layer (B').
(Example 3) The polymerization nature constituent (C) which consists of the nematic-liquid-crystal constituent "PN-019" 80 weight section used in the example 2, the caprolactone denaturation hydroxy pivalate neopentyl GIRIKORU diacrylate "HX-220" (Nippon Kayaku Co., Ltd. make) 13.6 weight section, the laurylacrylate "L-A" (Kyoeisha fatty chemistry industrial incorporated company make) 6 weight section, and the photopolymerization initiator "inter-record-gap-651" (product made from Ciba-Geigy) 0.4 weight section was prepared. Next, it is an electrode layer (A") as size 25mmx30mm as shown in a view 6, and an ITO transparent-electrode layer. it is indicated in a view 7 as the glass substrate (v) which has (B") and (C") -- as -- the same size as a glass substrate (v) -- and prepared the glass substrate (vi) which has an ITO transparent-electrode layer all over a substrate, the electrode stratification plane of a glass substrate (v) and a glass substrate (vi) was made to counter, and the polymerization nature constituent (C) prepared in the meantime was made to pinch The interval between the glass substrates at this time was set up so that it might become 12 microns. By irradiating the ultraviolet rays of the energy which uses the metal halide lamp of 80W for the polymerization nature constituent pinched by these two substrates, and is equivalent to 500 mJ/cm2, the polymerization of the polymerization nature constituent was carried out, and the liquid crystal cell which has the modulated light layer which consists of a transparency solid matter and liquid crystal material between two substrates was produced. The optical different direction film produced in the example 1 was put on this liquid crystal cell, and this has been arranged between the polarization films of two sheets with which a polarization shaft intersects perpendicularly mutually. At this time, the optical axis (the direction of rubbing) of an optical different direction film made the angle of 45 degrees to the polarization shaft of a polarization film. Moreover, the liquid crystal cell and the optical different ****** film were piled up so that the portion whose interference color of an optical different direction film is red might lap with the portion of the electrode layer (A") of a liquid crystal cell, a portion with the green interference color of an optical different direction film might lap with the portion of the electrode layer (B") of a liquid crystal cell and the portion whose interference color of an optical different direction film is blue might lap with the portion of the electrode layer (C") of a liquid crystal cell Thus, as for the produced liquid crystal display element, the display of nebula [voltage] (white) of the portions of an electrode layer (A"), (B"), and (C") at the time of no impressing was obtained. Moreover, as for the portion of an electrode layer (A"), skillful coloring with the portions of red and an electrode layer (B") blue [the portions of green and an electrode layer (C")] was obtained by impression of voltage.
[0062]
[Effect of the Invention] The optical different direction film of this invention can be colored with combination with a polarization film based on the optical phase contrast, and can be used as a light filter for liquid crystal display elements. Moreover, since optical phase contrast differs corresponding to each pixel, the number of color schemes can be increased, without carrying out the laminating of the phase contrast film. Moreover, in order that coloring may depend the liquid crystal display element using the this optical different direction film on combination with the polarization film based on optical phase contrast, as compared with the liquid crystal display element colored using absorption of coloring matter etc., decline in a light transmittance is small and a bright display is obtained.

[Translation done.]

Drawing selection drawing 2

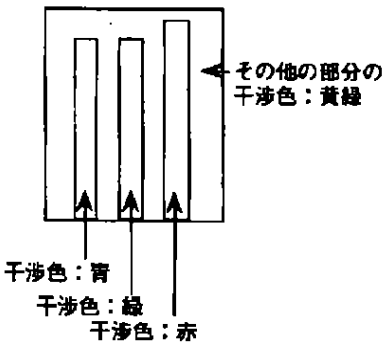
第 2 図



[Translation done.]

Drawing selection drawing 3

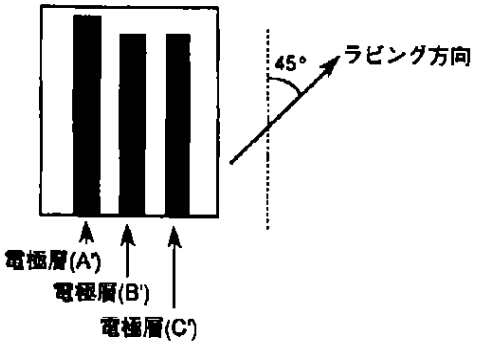
第 3 図



[Translation done.]

Drawing selection drawing 4

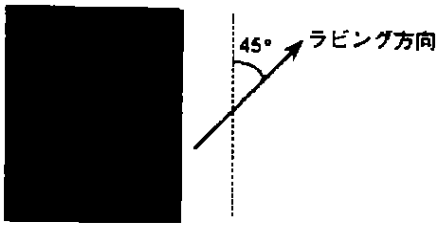
第 4 図



[Translation done.]

Drawing selection drawing 5

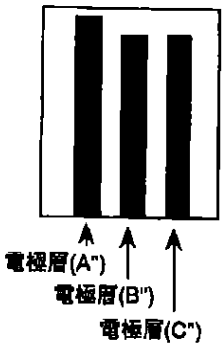
第 5 図



[Translation done.]

Drawing selection drawing 6

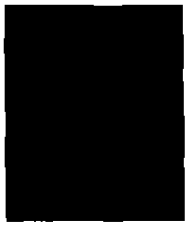
第 6 図



[Translation done.]

Drawing selection drawing 7

第 7 図



[Translation done.]